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Factsheet

HORSE MANAGEMENT

ANATOMY AND PHYSIOLOGY OF REPRODUCTION IN THE MARE

This material was originally prepared by Les Burwash, Horse Industry Branch, Alberta Agriculture and has been adapted for use by the Ministry of Agriculture and Food, Animal Industry Branch into Factsheet format by Dr. R.G. Wright, Co-ordinator for Equine Program.

Horses have the potential for high reproductive performance, yet many horsemen do not understand the basics well enough to exploit this potential. On breeding farms, as many as 40% of the mares either do not conceive, suffer embryonic loss or experience stillbirth.

Once the choice of mating a selected stallion to a particular mare is made, the goal is to have each mare give birth to a live, healthy foal each year.

Since the gestation period (period from breeding to foaling) is approximately 340 days, this leaves only 25-30 days to rebreed the mare to foal within the year, (365 days). Thus, a good understanding is essential.

The objective of this factsheet, which is one of the Horse Management series under Agdex Number 460-10, is to present information on reproduction and management, that will assist in obtaining maximum reproductive performance in the horse.

Basic functions of the parts of the reproductive tract:

- **Vulva** – The vulva is the external opening of the urogenital tract. It is part of the birth canal and the area where urine is voided.
- **Vagina** – The vagina lies in the pelvic girdle between the vulva and cervix. It is part of the birth canal and under natural service, is the area of semen deposition.

ANATOMY OF THE REPRODUCTIVE TRACT OF THE MARE

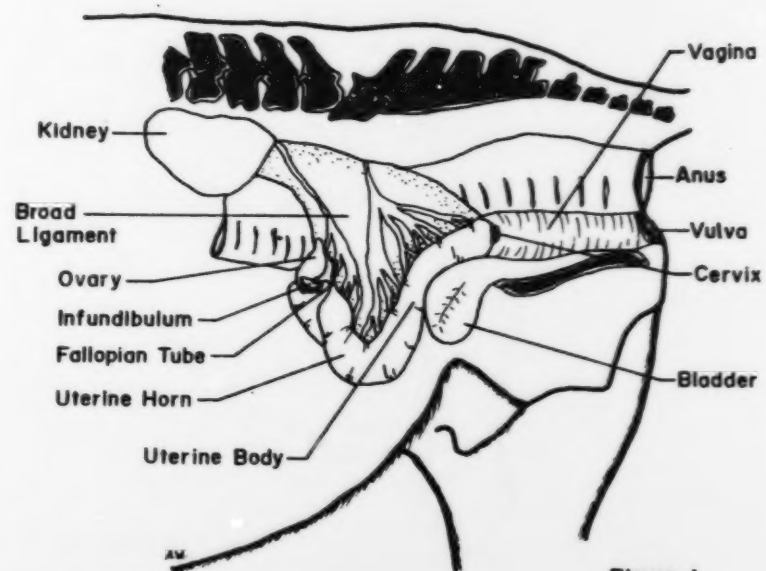

Figure 1

- **Cervix** – The cervix is a structure of approximately 10 cm (4 inches) in length lying between the vagina and the uterus. It is the "door to the uterus" and attempts to maintain a stable environment in the uterus. It relaxes when the mare is in heat and closes when she is not, and when she is pregnant.

- **Uterus** – The uterus or womb consists of a large uterine body, just anterior to the cervix, and two relatively short uterine horns that terminate in the fallopian tubes. The uterus is where the major portion of embryonic development and nourishment takes place. It also serves as an endocrine gland producing hormones.

- **Fallopian Tube** – This is a long convoluted tube extending from the infundibulum to the end of the uterine horns. It serves to transport sperm and ova to the site of fertilization which occurs in the upper one-third of the fallopian tube. The fertilized ovum is then transported to the uterus.

- **Infundibulum (fimbria)** – This is the "catchers mitt" like structure at the ovarian end of the fallopian tube which picks up the ovum from the ovary at ovulation and transports it down into the fallopian tube.

- **Ovary** – This is the primary sex organ of the mare. The ovary produces the ovum (egg) to be fertilized and serves as an endocrine gland producing the hormones estrogen and progesterone.

- **Broad Ligament** – This is a tough layer of fibrous tissue, containing blood vessels and nerves, that suspends the majority of the reproductive tract in the abdomen.

NORMAL ESTROUS CYCLE

Once the mare has started to cycle normally (usually in late April or early May), she will have an estrous cycle of 21 days plus or minus 3 days. The cycle is composed of the estrus period (heat) and the diestrual period (out of heat). Estrus usually lasts for 6 or 7 days, but may be 4 to 10 days in duration depending on the mare. Diestrus is normally 15 days in duration but may vary from 12 to 18 days.

One of the problems associated with equine breeding is the uncertainty of the time of ovulation. Ovulation, the release of the egg from the ovary can occur at any time during estrus. However, it normally occurs 24 to 48 hours before the end of the estrus period. A great deal of time is consumed by regular teasing to detect estrus behavior and by rectal palpation to determine the time of ovulation. Ideally, for maximum conception, breeding should be within 12 hours of ovulation. Breeding or insemination of mares, starting on day 2 or 3 of estrus and continuing on an every other day basis throughout the estrus, is a practical means of achieving satisfactory pregnancy rates.

INFLUENCE OF SEASON

The mare is seasonally polyestrus, which means that she has multiple heat periods which tend to be concentrated in late spring and summer. This is the normal breeding season for horses. In late December, January, February and March, less that 20% of the mares are ovulating. Very few mares are cycling normally at this time, thus conception is very difficult to achieve.

In April about 40% of mares are ovulating which increases to 70% in May and over 90% in June, July and August. Since so few mares ovulate early in the year, breed associations that have January 1 as a birth date for all foals born in that calendar year are encouraging their members to balance their breeding program when the chances of success are limited. A March 1 birth date would appear to be a more suitable date.

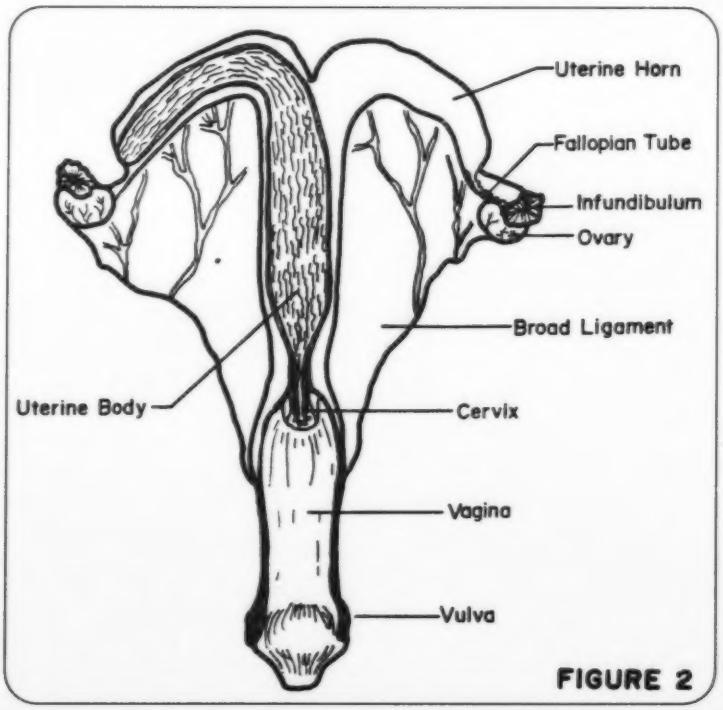

FIGURE 2

The mares' first estruses each year are often erratic and prolonged during which time mares may be in heat for 20 to 30 days or more. Recent work at Colorado State University indicates that the longer a mare remains in estrus during the transition period, the greater the chance of becoming pregnant during the prolonged estrus and in the subsequent estrus. During late March, April and May most mares begin exhibiting sexual activity, and from late April through August, most mares will cycle normally. A good rule of thumb to determine when mares are starting to cycle normally is that they have at least 4 consecutive days of estrus followed by at least 8 consecutive days of diestrus.

The primary environmental factor causing mares to cycle normally is increased hours of light (photoperiod). Artificial lighting can be used to induce mares to cycle earlier in the year. Increased environmental temperatures have no influence on stimulating mares to cycle, but increased quality and quantity of feed may have some effect.

HORMONAL INFLUENCE

The estrous cycle is controlled by hormones. A hormone is a substance produced by a ductless gland and transmitted via the blood stream to another organ where a response is elicited.

The major organs of interest reproductively are the pituitary gland, the ovaries and the uterus. The pituitary gland is located at the base of the brain and produces the hormones follicle stimulating hormone (FSH) and luteinizing hormone (LH).

As spring approaches, the pituitary gland is stimulated by increased daylight to enhance FSH production. FSH is released into the blood stream and travels to the ovaries to initiate development of a follicle containing an ovum. The developing follicle produces estrogens which are released into the blood stream.

Estrogens have a number of functions in the body. When blood estrogen reaches a certain level, there is a surge of LH released from the pituitary into the blood stream. Also, estrogens in the blood act upon the brain to put the mare into the physical state of being in estrus, resulting in the external signs of estrus. Estrogens also act on the fallopian tube, uterus and cervix to prepare the reproductive tract for pregnancy.

In the early part of the breeding season when 20 to 30 day estruses are observed, probably insufficient FSH is being produced for "normal" follicular development. As well, very small follicles are often produced resulting in insufficient estrogen released to cause the LH surge but sufficient to cause the mare to exhibit the physical signs of estrus. Less than 20 per cent of these early estruses result in ovulation; thus it is impractical to breed mares during this time without rectal palpation of the ovaries to determine follicular development.

The increased estrogen level stimulates an LH surge which causes the follicle on the ovary to rupture and ovulation is the result. As the follicle develops on the ovary, the ovum (egg) inside the follicle undergoes a number of changes to become capable of being fertilized by the sperm. The follicle contains a viscous fluid and when the follicular wall ruptures this fluid flows out carrying the ovum with it. The cavity left by the ruptured follicle becomes engorged with blood to form a corpus hemorrhagicum (CH). The CH luteinizes to form the corpus luteum (CL), sometimes called the yellow body.

As the CL develops, it starts to produce progesterone which influences the pituitary and reproductive tract. The

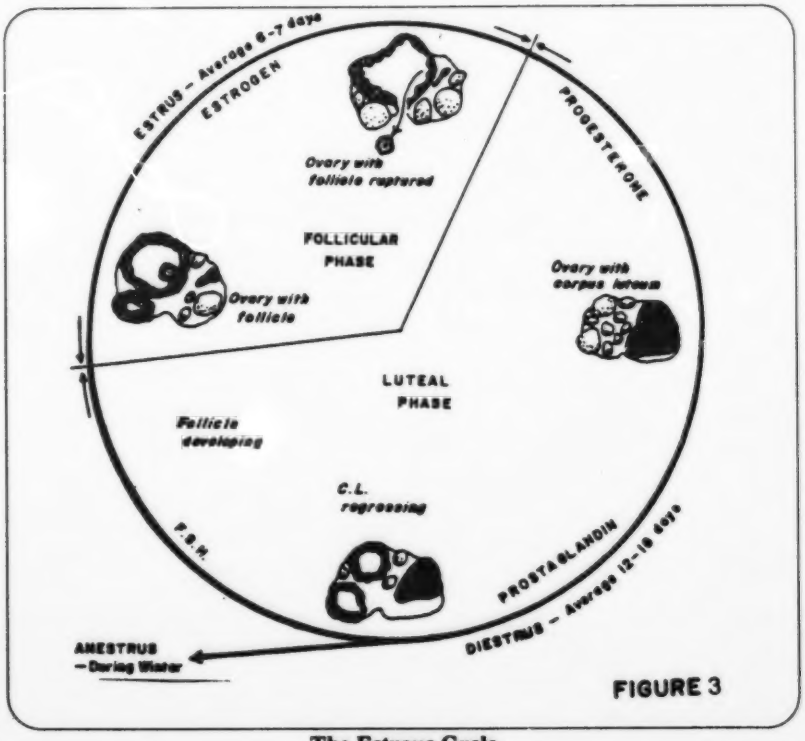

FIGURE 3

The Estrous Cycle

feedback of progesterone via the blood stream inhibits the release of FSH and LH and causes the mare to stop showing estrus. The latter is due in part to the fact that estrogen levels are decreasing. Progesterone activity on the reproductive tract is also very important in that the uterus changes from a fairly active motile organ to a quiescent, stable organ. Progesterone function is to maintain the pregnancy by maintaining a uterine environment conducive to fetal development.

If the mare does not conceive the CL remains functional for about 12 to 14 days. At this time, another hormone released from the endometrium (inner lining of the uterus), Prostaglandin $F_2\alpha$ ($PGF_2\alpha$), is carried to the CL via the blood, causing the CL to regress (luteolytic activity). As the CL regresses, the progesterone production decreases, thus blood progesterone levels are reduced, resulting in the removal of the inhibition of FSH and LH production and secretion. The cycle starts over again. (Figure 3)

If the mare conceived during estrus, the hormonal activities are essentially the same up to approximately 12 to 14 days post ovulation. The developing embryo migrates throughout the uterus. This action stimulates pregnancy recognition. The result is an antiluteoytic effect that inhibits $PGF_2\alpha$ release. The CL remains functional, progesterone levels are maintained and the pregnancy is continued.

Somewhere between day 25 and 30 of gestation the primary CL (CL formed from the ovulation resulting in the pregnancy) starts to regress resulting in declining blood progesterone levels. If the progesterone level was to continue decreasing, the pregnancy would be terminated, thus a compensatory system has evolved that is unique to the mare. Between the 25th and 36th day of gestation a girdle-like band of special cells develops around the fetal sac. On about day 37 of gestation this band detaches from the fetal membranes and invades the endometrial (uterine) wall where these cells undergo tremendous enlargement and structural change. These cells clump to form the endometrial cups which produce the hormone pregnant mare serum gonadotrophin (PMSG). PMSG reaches the ovaries via the blood stream stimulating secondary follicular development and luteinization. The secondary CL's produce progesterone, as does the primary CL to day 130 to 150 of gestation. From about day 80 of pregnancy to term, adequate progesterone levels are maintained by special areas of the uterus and/or fetal membranes to sustain the pregnancy.

From day 45 to about day 120 a serological test for pregnancy is available which detects the presence of PMSG in the blood. The test does not guarantee that the mare is pregnant but does indicate if the mare was pregnant up to day 37 of gestation. It is advisable to have the mare checked for pregnancy by a veterinarian, approximately 40 and 120 days post breeding. This will confirm the serological test and/or the ultrasound results, so management of the mare will be dependent on the pregnancy exam.

The pregnant mare foals (parturition) 340 + 20 days post breeding. Initiation of parturition is very complex and not completely understood. Mechanical stimuli occur from distension of the uterus which brings about an increased sensitivity of the uterus to the hormones, estrogen and oxytocin. At the end of pregnancy the uterus becomes active and the cervix dilates. Oxytocin, a hormone from the pituitary, is released which causes the muscles of the uterus to contract and expel the fetus (foal). The fetus probably plays a role in initiating parturition as well.

FERTILIZATION

The site of semen deposition in the mare is in the vagina (natural breeding) or the uterine body (artificial insemination). Actual time for sperm to move from the point of deposition to the area of fertilization has not been determined; this area being the upper one-third of the fallopian tube. The muscular movements of the uterus and fallopian tubes under the influence of estrogens are responsible for the rapid migration of sperm.

The follicle ruptures releasing the ovum to be picked up by the fimbria (infundibulum). The fimbria funnels the ovum into the fallopian tube, where it comes in contact with the sperm. The union of the sperm and ovum forms the zygote or the beginning of an embryo. The embryo moves down the fallopian tube to the uterus. The time required to move the embryo from the site of fertilization into the uterus is about six days. By this time the uterus has been under the influence of ovarian progesterone so as to create a suitable environment for fetal development and implantation.

Recent studies by Ginther have shown that the embryo is relatively mobile within the uterus. Mobility ceases on day 16 to 17 post ovulation because of the increased uterine tone, thickening of the uterine wall and enlargement of the vesicle. Movement throughout the uterus plays a physiologic or metabolic role in the inhibition of the mare recycling and/or is a biological embryo-reduction mechanism to reduce twinning. Implantation is not complete in the mare until as late as day 50 post breeding. Up to this time, the fetal sac lies unattached in the lumen of the uterus.

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